

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No: 10/673,000
Applicant: Anne Skaja Robinson, et al.
Filed: Sept. 26, 2003
Title: Use of hydrostatic pressure to inhibit and reverse protein aggregation and facilitate protein refolding
TC/A.U.: 1639
Examiner: Amber D. Steele
Confirmation No.: 9773
Docket No.: UOD-154US1

DECLARATION OF ANNE SKAJA ROBINSON UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Dr. Anne Skaja Robinson hereby declare

1. I am a co-inventor of the subject matter described and claimed in U.S. Patent Application Serial No. 10/673,000.
2. I am currently employed by the University of Delaware, the assignee of U.S. Patent Application Serial No. 10/673,000.
3. The resume attached herein as an Appendix accurately reflects my professional credentials.
4. I have reviewed the application, including the Office Action of January 6, 2009.
5. On pages 5-6 of the Office Action, the Examiner states that claims 1-12 of the application are rendered obvious by the combination of the Bonafe (Biochemistry 33: 2651-2660, 1994) and Litt (US 6,635,469) references.
6. I understand that obviousness may be rebutted by evidence that the claimed invention possesses unexpectedly advantageous or superior properties.

7. I have reviewed these two references and discuss reasons why the claimed invention would not be obvious in view of these references in paragraphs 8-11 below.

8. As stated in paragraph [0028] of the published application, US 2005/0020818, a surprising result of the claimed process is that it can substantially increase the recovery level of refolded protein, compared to that recoverable by traditional methods for protein refolding. The partially unfolded intermediates appear to preferably refold into the conformation of the native protein, instead of re-aggregating upon release of pressure.

9. As stated in paragraph [0029], one benefit of the invention is that the method may be performed without denaturants. The method is more cost-effective, because there is no need to change buffers or dilute protein to produce native proteins.

10. As stated in paragraphs [0041] and [0043], the claimed method is successful at high protein concentrations, which is a condition that typically favors aggregation in vitro and the formation of inclusion bodies in vivo.

11. In my opinion, the methods taught by Bonafe and Litt, alone or in combination, do not render these surprising results and advantages predictable.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,


Anne Skaja Robinson, Ph.D.

3/27/09
Date

APPENDIX

ANNE SKAJA ROBINSON

Professor of Chemical Engineering
University of Delaware
Newark, DE 19716
PH: (302) 831-0557

EDUCATION

- 1994 **Ph.D., Chemical Engineering** University of Illinois at Urbana-Champaign
Dissertation: *"Engineering the Yeast Secretory Pathway: The role of BiP and PDI in the secretion of foreign proteins in Saccharomyces cerevisiae."*
Advisors: Prof. Douglas A. Lauffenburger, Prof. K. Dane Wittrup
- 1989 **M.S., Chemical Engineering** The Johns Hopkins University
Thesis: *"Isolation and Characterization of Proteolytic Enzymes from the Hyperthermophilic Archaeobacterium Pyrococcus furiosus."*
Advisor: Prof. Robert M. Kelly
- 1988 **B.S., Chemical Engineering** The Johns Hopkins University
Departmental Honors GPA 3.89/4.0

PROFESSIONAL EXPERIENCE

- 2008-present **Associate Chair for Biochemical Engineering**
University of Delaware, Department of Chemical Engineering
- 2008-present **Full Professor**
University of Delaware, Department of Chemical Engineering
- 2003-2008 **Associate Professor**
University of Delaware, Department of Chemical Engineering
- 1997-2003 **Assistant Professor**
University of Delaware, Department of Chemical Engineering
- 1994-1997 **Postdoctoral Fellow**
Massachusetts Institute of Technology, Department of Biology
Advised by Professor Jonathan King.
- 1990-1994 **Research Assistant**
University of Illinois at Urbana-Champaign, Department of Chemical Engineering
Advised by Professor Douglas A. Lauffenburger and Professor K. Dane Wittrup.
- 1990-1992 **Graduate Teaching Assistant**
University of Illinois at Urbana-Champaign, Department of Chemical Engineering
Courses taught: Material and Energy Balances, Plant Design, Unit Operations Lab
- 1986 **Guest Researcher**
National Institutes of Health (NIAID), Bethesda, Maryland.

ACADEMIC HONORS

- 2002 Outstanding Junior Faculty Member, College of Engineering, University of Delaware
- 2000-2005 NSF Presidential Early Career Award in Science and Engineering (PECASE/Career)
~400 Career Awards/year. PECASE award for subset of Career Award winners – 20
awarded for all NSF Directorates in 2000, of which only 2 were to chemical
engineers.
- 2000-2003 DuPont Young Professor
- 2000 National Academy of Engineering, Sixth Annual Frontiers in Engineering,
One of 100 invited participants, Irvine, CA
- 1996-97 NIH Postdoctoral Fellowship (~900 awarded/yr)
- 1992-94 Clare Booth Luce Graduate Fellowship (~350 awarded since 1970)
- 1989-92 Department of Defense Fellowship (NDSEG) (~100 awarded/yr)
- 1988-89 NSF Creativity Award for Scientists and Engineers
~20 awarded/yr following review of proposal and personal interview
- 1988 National Science Foundation Fellowship awarded (declined)
(~30 in Chemical Engineering/yr of 900 awarded in all disciplines)
- 1988-89 Tau Beta Pi Fellowship (~30 awarded/yr)
- 1984-88 Beneficial Hodson Scholarship, Johns Hopkins University (~15 awarded/yr)

PATENTS

- A) Kelly, R.M., A.K.S. Robinson, I.I. Blumentals, S.H. Brown, and C.B. Anfinsen. "Proteolytic Enzymes from Hyperthermophilic Bacteria and Processes for Their Production." Patent # 5,242,817. Filed 9/12/89. Accepted 9/7/93. Licensed to Takara Shuzo.
- B) Robinson, A.S. and K.D. Wittup. "Methods for Increasing Secretion of Overexpressed Proteins." Patent # 5,773,245. Filed 10/92. Accepted 6/30/98.
- C) Robinson, A.S., D. Foguel, J.L. Silva, C.R. Robinson. "Use of Hydrostatic Pressure to Inhibit and Reverse Protein Aggregation and Facilitate Protein Refolding." Patent applied for, 60/161,035. Filed 10/99.

BOOK PUBLICATION

- 1) Russell, T.W.F., Robinson, A.S., and Wagner, N.J., (2008) Mass and Heat Transfer: Analysis of Mass Contactors and Heat Exchangers. Cambridge University Press, Cambridge, UK (www.cambridge.org/9780521886703).

JOURNAL PUBLICATIONS (46 TOTAL; 3 CURRENTLY UNDER REVIEW;

* = CORRESPONDING AUTHOR, † = UNDERGRADUATE STUDENT)

CITATIONS AS OF 7/1/07 IN BRACKETS, WHERE AVAILABLE

- 1) Blumentals, I. I., R. M. Kelly, A.K. Skaja [Robinson] and J. Shiloach* (1987) "Effect of Culturing Conditions on the Production of Exotoxin A by *Pseudomonas aeruginosa*." *Ann N Y Acad. Sci.* **506**, 663-668. [5]
- 2) Blumentals, I. I., A. S. Robinson and R. M. Kelly* (1990) "Characterization of Sodium Dodecyl Sulfate Resistant Proteolytic Activity in the Hyperthermophilic Archaeobacterium *Pyrococcus furiosus*." *Appl. Envir. Microbiol.* **56**, 1992-1998. [80]
- 3) Blumentals, I.I., S.H. Brown, R.N. Schicho, A.K. Skaja [Robinson], H.R. Costantino, and R.M. Kelly*. (1990) "The Hyperthermophilic Archaeobacterium, *Pyrococcus furiosus*: Development of

- Culturing Protocols, Perspectives on Scale-Up, and Potential Applications." *Ann. N.Y. Acad. Sci.*, **589**, 301-314. [not indexed]
- 4) Robinson, A.S. and K.D. Wittrup* (1993) "Role of the Protein Folding Chaperone BiP in Secretion of Foreign Proteins in Eucaryotic Cells." in *Protein Folding: In vivo and In vitro*. ACS Symposium Series 526. Jeffrey Cleland, Ed., 121-132. [2]
 - 5) Robinson, A.S., V. Hines, and K.D. Wittrup* (1994) "Overexpression of Protein Disulfide Isomerase Increases Secretion of Foreign Proteins in the Yeast *Saccharomyces cerevisiae*." *BioTech. 12*, 381-384. [91]
 - 6) Wittrup*, K.D., A.S. Robinson, R.N. Parekh, and K.J. Forrester (1994) "Existence of an Optimal Expression Level for Secretion of Foreign Proteins in Yeast." *Ann. N.Y. Acad. Sci.* **745**, 321-330. [10]
 - 7) Robinson, A.S. and K.D. Wittrup* (1995) "Constitutive Overexpression of Secreted Heterologous Proteins Decreases Extractable BiP and PDI Levels in *Saccharomyces cerevisiae*." *Biotech Prog.* **11**, 171-177. [32]
 - 8) King*, J., C. Haase-Pettingell, A.S. Robinson, M. Speed, and A. Mitraki (1996) "Thermolabile Folding Intermediates: Inclusion Body Precursors and Chaperonin Substrates" *FASEB J.*, **10**, 57-66. [96]
 - 9) Robinson, A.S., J.A. Bockhaus†, A.C. Voegler, and K.D. Wittrup* (1996) "Reduction of BiP levels decreases heterologous protein secretion in *Saccharomyces cerevisiae*" *J. Biol. Chem.* **271**, 10017-10022. [51]
 - 10) Robinson, A.S. and D.A. Lauffenburger* (1996) "Model for ER Chaperone Dynamics and Secretory Protein Interactions." *AIChE J.* **42**, 1443-1453. [5]
 - 11) Robinson, A.S. and J. King* (1997) "Disulfide-Bonded Intermediate on the Folding and Assembly Pathway of a Non-Disulfide Bonded Protein." *Nature Struct. Biol.*, **4**, 450-455. [40]
 - 12) Foguel, D., Robinson, C.R., Caetano de Sousa Jr., P., Silva, J. L. and A.S. Robinson* (1999), "Hydrostatic Pressure Rescues Protein Aggregates", *Biotech. Bioeng.* **63**, 552-558. [51]
 - 13) Haase-Pettingell, C., Betts, S., Raso, S.W., Stuart, L., Robinson, A. and J. King* (2001), "Role for Cysteine Residues in the In Vivo Folding and Assembly of the Phage P22 Tailspike," *Protein Sci.* **10**, 397-410. [19]
 - 14) Kauffman, K., P. Dhurjati, A.S. Robinson, and F.J. Doyle III "Framework for Modeling Information Flow in Biological Processes: Application to the Unfolded Protein Response." *Proc. IFAC Conf. Comput. Appl. Biotech (CAB)*, 2001.
 - 15) Kauffman, K., Pridgen, E.M. †, Doyle, F.J. III, Dhurjati, P., and A.S. Robinson* (2002) "Decreased Protein Expression and Oscillating BiP Levels Result during Heterologous Protein Expression in *S. cerevisiae*," *Biotech. Prog.*, **18**, 942-940 [16]
 - 16) Sinacola, J. and A.S. Robinson* (2002) "Rapid refolding and polishing of single-chain antibodies from *E. coli* inclusion bodies" *Protein Exp. Purif.*, Vol. 26, No. 2, Nov 2002, pp. 301-308. [7]
 - 17) Smith, J.D. and A.S. Robinson* (2002) "Overexpression of an archaeal enzyme in a eucaryotic host: A secretion bottleneck at the ER," *Biotech. Bioeng.*, **79**, 7, p. 713-723. DOI: 10.1002/bit.10367 [15]

Publications since promotion to Associate Professor:

- 18) Lefebvre, B.G., and A.S. Robinson* (2003), "Pressure treatment of tailspike aggregates rapidly produces on-pathway folding intermediates," *Biotech. Bioeng.*, **82**, 5, p. 595-604. DOI: 10.1002/bit.10607 [15]

- 19) Danek, B.L., and A.S. Robinson^{*} (2003) "Non-native interactions between cysteines direct productive assembly of P22 tailspike protein," *Biophys J.*, **85**, 5, p. 1-11. [7]
- 20) Butz, J., Niebauer, R. T., and A.S. Robinson^{*} (2003), "Co-expression of molecular chaperones does not improve the heterologous expression of mammalian G-protein coupled receptor expression in yeast," *Biotech. Bioeng.*, **84**, 3, p. 292-304. DOI: 10.1002/bit.10771. [14]
- 21) Gage, M.J. and A.S. Robinson^{*} (2003) "C-terminal Hydrophobic Interactions Play a Critical role in Oligomeric Assembly of the P22 Tailspike Trimer," *Protein Sci.*, **12**, 12, p. 2732-47. [5]
- 22) Smith, J.D., Tang, B.C. [†], and A.S. Robinson^{*} (2004) "Protein disulfide isomerase, but not binding protein, overexpression enhances secretion of a non-disulfide-bonded protein in yeast", *Biotech. Bioeng.*, **85**, 3, p. 340-50. [11]
- 23) Niebauer, R. T. and A.S. Robinson^{*} (2004) "Saccharomyces cerevisiae protein expression: From protein production to protein engineering" in Expression Technologies, Horizon Scientific Press. [2]
- 24) Lefebvre, B.G., Gage, M.J., and A.S. Robinson^{*} (2004) "Maximizing Recovery of Native Protein from Aggregates by Optimizing Pressure Treatment," *Biotechnology Progress*, **20**, 2, p. 623-629. [5]
- 25) Lefebvre, B.G., Comolli, N.K. [†], Gage, M.J. and A.S. Robinson^{*} (2004), "Pressure dissociation studies provide insight into oligomerization competence of temperature-sensitive mutants of P22 tailspike," *Protein Sci.*, **13** (6) 1538-46. [1]
- 26) Danek, B.L. and A.S. Robinson^{*} (2004) "P22 tailspike trimer assembly is governed by interchain redox associations," *Biochem. Biophys. Acta*, **1700**(1):105-16. [5]
- 27) Niebauer, R.T., Wedekind, A. [†] and A.S. Robinson^{*} (2004) "Decreases in yeast expression yields of the human adenosine receptor are a result of translational or post-translational events", *Protein Exp. Purif.*, **37** (1) 134-143. [7]
- 28) Xu, P., Raden, D., Doyle, F.J. III, and A.S. Robinson^{*} (2005) "Analysis of unfolded protein response during single-chain antibody expression in *Saccharomyces cerevisiae* reveals different roles for BiP and PDI in folding", *Metabolic Engineering*, **7** (4) 269-279. [4]
- 29) Gage, M.J., Zak, J. [†] and A.S. Robinson^{*} (2005) "Three Amino Acids that are Critical to Formation and Stability of the P22 Tailspike Trimer", *Protein Science*, **14** (9) 2333-43. [1]
- 30) Smith, J.D., Richardson, N.E. and A.S. Robinson^{*} (2005) "Elevated expression temperature in a mesophilic host results in increased secretion of a hyperthermophilic enzyme and decreased cell stress," *Biochem. Biophys. Acta*, **1752** (1) 18-25. [1]
- 31) Raden, D., Hildebrandt, S., Xu, P., Bell, E. [†], Doyle, III, F.J. and A.S. Robinson^{*} (2005), "Analysis of cellular response to protein overexpression." IEE Proceedings: Systems Biology **152** (4) 285-289. [1]
- 32) Niebauer, R. T., and A.S. Robinson^{*} (2006) "Exceptional total and functional yields of the human adenosine (A2a) receptor expressed in the yeast *Saccharomyces cerevisiae*", *Prot. Exp. Purif.*, **46**, p. 204-211. [4]
- 33) Gage, M.J., Lefebvre, B.G., and A.S. Robinson^{*} (2006) "Determinants of Protein Folding and Aggregation in P22 Tailspike," in Misbehaving Proteins. ACS Publications, eds. Regina Murphy and Amos Tsai. [not indexed]
- 34) Kim, J. and Robinson, A.S.^{*} (2006) Dissociation of intermolecular disulfide bonds in P22 tailspike protein intermediates in the presence of SDS, *Protein Science*, **15** (7), p. 1791-3. [1]
- 35) Wedekind, A.L. [†], O'Malley, M., Niebauer, R.T., and Robinson, A.S.^{*} (2006) Optimization of the Human Adenosine A_{2a} Receptor Yields in *Saccharomyces cerevisiae*, *Biotechnology Progress*, **22**(5):1249-55. [1]

- 36) Powers, S.L., Robinson, C.R., and Robinson, A.S.* (2007) Denaturation of an Extremely Stable Hyperthermophilic Protein Occurs via a Dimeric Intermediate, *Extremophiles*, 11(1):179-89. [1]
- 37) Forsten-Williams, K.F., Cassino, T.R., Delo, L.J., Bellis, A.D., Robinson, A.S., and Ryan, T.E., (2007) Enhanced Insulin-like Growth Factor-I (IGF-I) Cell Association at Reduced pH is Dependent on IGF Binding Protein-3 (IGFBP-3) Interaction, *Journal of Cellular Physiology*, 210(2):298-308.
- 38) Famá, M.C., Raden, D., Zacchi, N., Lemos, D.R., Robinson, A.S., and Silberstein, S.* (2007) "The *Saccharomyces cerevisiae* YFR041C/ERJ5 gene encoding a type I membrane protein with a J domain is required to preserve the folding capacity of the endoplasmic reticulum" *Biochim Biophys Acta*, 1773(2):232-42.
- 39) Bane, S.E., Velasquez, J.E.[†], and A.S. Robinson* (2007) "Expression and purification of milligram levels of inactive G-protein coupled receptors in *E. coli*", *Protein Expression and Purification*, 52(2):348:355.
- 40) Powers, S.L. and A.S. Robinson* (2007) "PDI Improves Secretion of Redox-Inactive β -glucosidase", *Biotech Prog.*, Mar-Apr,23(2):364-9. E-pub Feb 22, DOI: 10.1021/bp060287p
- 41) McCusker, E., O'Malley, M., Bane, S.E., and A.S. Robinson* (2007), "Heterologous GPCR expression: A bottleneck to obtaining crystal structures", *Biotech Progress*, May-Jun,23(3):540-7.
- 42) O'Malley, M., Lazarova, T., Britton, Z.T., and Robinson, A.S.,* (2007) "High-level expression in *Saccharomyces cerevisiae* enables isolation and spectroscopic characterization of functional human adenosine A_{2a} receptor", *J. Struct Biol.*, 159(2): 166-178.
- 43) McCusker, E., and Robinson, A.S.*, (2008) Refolding of G protein α subunits from inclusion bodies expressed in *Escherichia coli*, *Protein Exp. Purif.*, Apr,58(2): 342-55. Epub 2007 Dec 8.
- 44) Hildebrandt, S., D. Raden, L. Petzold, A.S. Robinson, and F.J. Doyle III* (2008) "A top-down approach to mechanistic biological modeling: application to the single-chain antibody folding pathway", *Biophysical Journal*, 95(8):3535-58. Epub 2008 Jul 18.
- 45) Webber T, Gurung S, Saul J, Baker T, Spataro M, Freyer M, Robinson AS, Gage MJ* (2009) "The C-terminus of the P22 tailspike protein acts as an independent oligomerization domain for monomeric proteins.", *Biochem J*. Feb 5. [Epub ahead of print]
- 46) Spataro ML, Roberts CJ, Robinson AS* (2009) "Kinetic folding studies of the P22 tailspike beta-helix domain reveal multiple unfolded states." *Biophys Chem*. Feb 12. [Epub ahead of print]

PEER-REVIEWED CONFERENCE PROCEEDINGS

- 47) Hildebrandt, S., D. Raden, E. Bell[†], A.S. Robinson, and F.J. Doyle III* (2005) "Modeling the Unfolded Protein Response in *Saccharomyces Cerevisiae*", Proc. Int. Conf. Foundations of Systems Biology, Santa Barbara, California. [not indexed]
- 48) Griesemer, M., Young, C., Raden, D., Petzold, L., Robinson, A.S., Doyle, F.J.* (2007) "Computational Modeling of Chaperone Interactions in the Endoplasmic Reticulum of *Saccharomyces cerevisiae*." Proc. Int. Conf. Foundations of Systems Biology, Stuttgart, Germany.
- 49) Yuraszcek, T., Raden, D., Robinson, A.S., and Doyle, F.J.* (2007) "Microarray Analysis of the Unfolded Protein Response in *S. cerevisiae* Reveals Evidence of Down-regulation." Proc. Int. Conf. Foundations of Systems Biology, Stuttgart, Germany.

MANUSCRIPTS SUBMITTED FOR REVIEW

- 50) Xu, P. and Robinson, A.S. (2009)

INVITED SEMINARS

- Department of Chemical and Biomolecular Engineering, Tulane University, March 2009
- Department of Chemical and Biomolecular Engineering, NC State University, November 2008
- Department of Chemical and Biological Engineering, Iowa State University, November 2008
- School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, November 2007, ACS Progress/Dreyfus Lectureship Award
- Department of Chemical Engineering, University of South Carolina, April 2007
- Department of Chemical Engineering, University of Massachusetts, Amherst, February 2007
- Department of Chemical Engineering, West Virginia University, January 2007
- Department of Chemical Engineering, University of Virginia, October 2006
- Department of Chemical and Biomolecular Engineering, University of Illinois, Urbana-Champaign, September 2006
- The Structure and Function of the Biological Membrane, Invited Speaker, Swiss NCCR Structural Biology, May 2006
- Institute for Cellular Engineering, U. Mass, Keynote Speaker, Amherst, May, 2006
- Difficult to Express Proteins, Invited Speaker, CHI Conferences, April 2006
- Department of Chemical Engineering, UC Santa Barbara, February 2006
- Department of Chemical Engineering, Rutgers University, NJ, November 2005
- Department of Chemical Engineering, Pennsylvania State University, State College, PA, March, 2005
- Department of Chemical Engineering, Drexel University, Philadelphia, PA, February 2004.
- Bioscience Symposium, University of Maryland at College Park, November 2003.
- Department of Chemical Engineering, University of Kansas, October 2003.
- Department of Chemical Engineering, University of Wisconsin, Madison, WI, October 2002.
- Merck Pharmaceuticals, West Point, PA, September 2002
- Department of Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA April 2002.
- Department of Chemical Engineering, Cornell University, Ithaca, NY, March 2002.
- Department of Chemical Engineering, University of Texas, Austin, TX, March 2002.
- Department of Chemical Engineering, University of Florida, Gainesville, FL, February 2002.
- Department of Chemical Engineering, University of Pennsylvania, Philadelphia, PA, January 2002.
- New Directions in Biotechnology Workshop, Biophysical Society Annual Meeting, February 2001, Boston, MA.
- Department of Chemical Engineering, University of Virginia, Charlottesville, VA, February 2001.
- Molecular Cell Biology and Biotechnology program, Virginia Polytechnic Institute, Blacksburg, September 2000.
- Department of Chemical Engineering, University of Massachusetts at Amherst, December 1999.
- Department of Chemical Engineering, Johns Hopkins University, November 1999.
- Department of Biology, University of Delaware, October 1998.
- DuPont Chemical Co., Wilmington, Delaware, October 1998.
- Department of Agricultural Sciences, University of Delaware, October 1998.
- Braslian Biochemical Society, XXVII Annual Meeting, Caxambu, MG, Brasil, May 1998.
- 3-Dimensional Pharmaceuticals, Exton, PA, January 1998.
- North Carolina State University, Department of Chemical Engineering, April 1997.
- University of Wisconsin, Department of Chemical Engineering, March 1997.
- University of Delaware, Department of Chemical Engineering, March 1997.

STUDENT CONFERENCE PRESENTATIONS

- 1) Danek, Brenda L.; Robinson, Anne Skaja. "Characterization of redox effects on the folding pathway of a nondisulfide bonded protein." 224th ACS National Meeting, Boston, MA, United States, August 18-22, 2002
- 2) Sinacola, Jessica R.; Robinson, Anne S. "Generation, characterization, and aggregation behavior of single-chain antibodies from *E. coli* inclusion bodies." 224th ACS National Meeting, Boston, MA, United States, August 18-22, 2002
- 3) Robinson, Anne Skaja; Sinacola, Jessica R. "Multiple active forms of single-chain antibody: Characterization and folding pathway analysis." 225th ACS National Meeting, New Orleans, LA, United States, March 23-27, 2003
- 4) Robinson, Anne Skaja; Niebauer, Ronald T.; Butz, James. "Engineering yeast for high-level expression of G-protein coupled receptors." 225th ACS National Meeting, New Orleans, LA, United States, March 23-27, 2003
- 5) Xu, P., D. Raden, F. J. Doyle III, A. S. Robinson. "Investigation of Cell Stress during Heterologous Protein Expression Using a Green Fluorescent Protein Stress Sensor". AIChE Annual Meeting, San Francisco, CA, November, 2003.
- 6) Kim, Junghwa; Robinson, Anne S. "Insights into the mechanism for the increase in native trimer yield." 227th ACS National Meeting, Anaheim, CA, United States, March 28-April 1, 2004.
- 7) Xu, Ping; Doyle, Francis J.; Robinson, Anne Skaja. "Investigation of cell stress during heterologous protein expression using a green fluorescent protein stress sensor." 227th ACS National Meeting, Anaheim, CA, United States, March 28-April 1, 2004
- 8) Richardson, N.E., J.D. Smith and A.S. Robinson. (2004) "Optimization of Expression of the Hyperthermophilic β -Glucosidase Protein in *Saccharomyces cerevisiae*" (Poster). Mid Atlantic Bioengineering Conference, University of Maryland Baltimore County, Baltimore, MD
- 9) Niebauer, Ronald T.; Robinson, Anne Skaja. Engineering yeast cells for optimal expression of membrane proteins. Abstracts of Papers, 227th ACS National Meeting, Anaheim, CA, United States, March 28-April 1, 2004 (2004)
- 10) Wedekind, Alison (undergraduate, poster); Robinson, Anne Skaja. "Optimizing expression of GPCRs in yeast." 227th ACS National Meeting, Anaheim, CA, United States, March 28-April 1, 2004
- 11) Powers, S.L. (speaker), Robinson, A.S., Robinson, C.R. Denaturation of an Extremely Stable Hyperthermophilic Protein. Oral Presentation, American Society for Microbiology Extremophiles 2004, Cambridge, MD.
- 12) Powers, S.L., Robinson A.S., Robinson, C.R. (Poster) Determinants of Equilibrium Stability of a Hyperthermophilic Protein. Biophysical Society 2004, Baltimore, MD
- 13) Powers, S.L., Robinson, A.S., Robinson, C.R. Determinants of Equilibrium Stability of a Hyperthermophilic Protein. (Poster) Proteins Gordon Conference, Plymouth, NH, June 2005.
- 14) Robinson, Anne Skaja; Kim, Junghwa; Gage, Matthew; Lefebvre, Brian. Determinants of P22 tailspike assembly and aggregation. Abstracts of Papers, 229th ACS National Meeting, San Diego, CA, United States, March 13-17, 2005.

- 15) Xu, P., D. Raden, C.A., Gelmi, S., Hildebrandt, F. J., Doyle III, and A.S., Robinson. "Genomic Wide Responses to Heterologous Protein Expression in *Saccharomyces cerevisiae*". Mid-Atlantic Bioengineering Consortium (MABEC), Rutgers University, NJ, April 2005.
- 16) Young, C.L. and A.S. Robinson Chaperone Interactions in the ER. (Poster) Molecular Chaperones & the Heat Shock Response Meeting, Cold Spring Harbor Laboratory, NY. May 2006
- 17) Young, C.L. and A.S. Robinson Chaperone Interactions in the ER. (Poster) MABEC (Mid-Atlantic Biochemical Engineering Consortium), Raleigh, NC. June 2006
- 18) Bane, Steven E. and A.S. Robinson "Expression and characterization of inactive human NK1R, a G-protein coupled receptor, from *Escherichia coli*." Talk at MABEC (Mid-Atlantic Biochemical Engineering Consortium), Raleigh, NC. June 2006
- 19) O'Malley, Michelle A. and Robinson, Anne S. "High-level expression and purification of the human adenosine A2a G-protein coupled receptor." (Poster) MABEC (Mid-Atlantic Biochemical Engineering Consortium), Raleigh, NC. June 2006
- 20) O'Malley, Michelle A. and Robinson, Anne S. "High-level expression and purification of the human adenosine A2a G-protein coupled receptor." 232nd ACS National Meeting, San Francisco, CA, United States, Sept. 10-14, 2006.
- 21) Bane, Steven E. and Robinson, Anne S. "Expression and characterization of inactive human NK1R, a G-protein coupled receptor, from *Escherichia coli*." 232nd ACS National Meeting, San Francisco, CA, United States, Sept. 10-14, 2006
- 22) McCusker, Emily Clare; Robinson, C. R.; and Robinson, Anne S. "Refolding of G-protein alpha subunits from inclusion body expression in *Escherichia coli*." 232nd ACS National Meeting, San Francisco, CA, United States, Sept. 10-14, 2006.
- 23) Yuraszek, T., Raden, D., Robinson, A.S., and Doyle, F.J. III "Dynamic analysis of the UPR suggests a pathway conferring down-regulation in *Saccharomyces cerevisiae*" (Poster) 2nd FEBS Advanced Lecture Course in Systems Biology: From Molecules to Life, March 10-16, 2007, Gosau, Austria. Note: Won award for best Poster Presentation.
- 24) McCusker, E., Bane, S.E. and Robinson, A.S., "Refolding Aggregation-prone GPCRs and G-protein subunits from inclusion bodies expressed in *Escherichia coli*," Proteins Gordon Research Conference, Holderness, New Hampshire, June, 2007. (invited)
- 25) Young, C.L. and A.S. Robinson Chaperone Interactions in the ER (Poster) EMBO-FEBS Molecular and Cellular Biology of Membranes Summer School, Cargese, Corsica, June 2007.
- 26) O'Malley, M. A., & A. S. Robinson, "Surfactant Effects on Activity and Structure of the Human Adenosine A_{2a} G-protein Coupled Receptor," American Chemical Society Colloids Division Meeting, Newark, DE, June 2007.
- 27) O'Malley, M., McCusker, E., and A.S. Robinson, (Poster) "Engineering *Saccharomyces cerevisiae* for the expression, purification, and characterization of G-protein coupled receptors", Biochemical Engineering XV, Quebec City, July 2007. Note: Won Best Overall Poster Award.
- 28) Spataro, M., C.J. Roberts, and A.S. Robinson, "Folding of the beta-helix domain of P22 tailspike protein", 233rd ACS National Meeting, Boston, MA, United States, August 19-23, 2007.
- 29) O'Malley, M. A., T. Lazarova, A. S. Robinson, "Biophysical Characterization of the Human Adenosine A_{2a} G-Protein Coupled Receptor Expressed from *Saccharomyces cerevisiae*",

American Institute of Chemical Engineering National Meeting, Salt Lake City, UT, November 2007.

- 30) O'Malley, M. A., T. Lazarova, A. S. Robinson, "Biophysical Characterization of the Human Adenosine A_{2a} Receptor", Joint Meeting of the Biophysical Society and the International Biophysics Congress, Long Beach, CA, February 2008.
- 31) Britton, Z. T., S. E. Bane, T. Polenova, A. S. Robinson. (Poster) "GPCR Expression in *E. coli*", Delaware Membrane Protein Symposium, Newark, DE, October 2008.
- 32) Britton, Z. T., T. Polenova, A. S. Robinson. (Poster) "System Development for Expression of GPCR Fragments", American Chemical Society National Meeting, Philadelphia, PA, August 2008.
- 33) Britton, Z. T., T. Polenova, A. S. Robinson. (Poster) "Development of a System for Expression of GPCR Fragments", Frontiers at the Chemistry and Biology Interface Symposium, College Park, MD, April 2008.
- 34) Naranjo, A. N., E. C. McCusker, A. S. Robinson, (Poster) "Role of the Disulfide Bond in A2a Adenosine Receptor", COBRE, Delaware Membrane Protein Symposium, Newark, DE, October 2008.
- 35) O'Malley, M. A., J. D. Mancini, C. L. Young, D. Raden, A. S. Robinson, "Engineering *Saccharomyces cerevisiae* for the Heterologous Expression of Mammalian G-protein Coupled Receptors", American Institute of Chemical Engineering National Meeting, Philadelphia, PA, November, 2008.
- 36) O'Malley, M. A., J. D. Mancini, C. L. Young, D. Raden, A. S. Robinson, "Engineering *Saccharomyces cerevisiae* for the Heterologous Expression of Mammalian G-protein Coupled Receptors", Annual Meeting of the American Chemical Society, Philadelphia, PA, August 2008.
- 37) O'Malley, M.A., J. D. Mancini, C. L. Young, D. Raden, A. S. Robinson, (Poster) "Engineering *Saccharomyces cerevisiae* for the Expression and Biophysical Characterization of G-Protein Coupled Receptors", FASEB Meeting on Molecular Biophysics of Cellular Membranes, Saxtons River, VT, July 2008.

GRADUATE RESEARCH THESES

PhD Students

- 1) Brian Lefebvre, May 2002; High Pressure Dissociates Tailspike Aggregates and Promotes Native Structure Formation; Assistant Professor, Rowan University, NJ (2004-2008); Current Position, Research Scientist, DuPont & Co.
- 2) James Butz, June 2002; Characterizing and Optimizing GPCR Expression in Yeast; current position, Senior Scientist, Schering-Plough, NJ.
- 3) Brenda Danek, March 2003; Characterization of the Role of Disulfides in Folding of Tailspike Protein; J.D., 2008, NYU; current position: Law Clerk, Finnegan, Henderson, Farabow, Garrett & Dunner, LLP
- 4) Jessica Sinacola, August, 2003; Characterization and Reversal of the Aggregation of Single-Chain Antibodies; current position, Process Engineer, Sterile Process Technology & Engineering, Merck & Co, West Point, PA.
- 5) Jason Smith, July 2003; Folding and Expression of Extremophilic Enzymes; current position, Product Development Engineer, Cohera Medical, Pittsburgh, PA.

- 6) Ronald Niebauer, July 2005; Using GFP as a Sensor for Optimizing Expression of GPCRs; current position, Biotechnology Patent Examiner, US Patent Office, Washington, DC.
- 7) Junghwa Kim, June 2006; Roles of Folding Intermediate Conformation and Transient Disulfide Bonding on the Folding of P22 Tailspike Protein; current position, Scientist, PD Direct-Process Development Services, Invitrogen Corporation, Frederick, MD.
- 8) Sara Lawrence Powers, July 2006; Characterization and Expression of an Extremely Stable Hyperthermophilic Protein; current position, Biomatrix.
- 9) Ping Xu, July 2006; Sensing and Analyzing the Unfolded Protein Response during Heterologous Protein Production; current position, post-doctoral fellow, Weill Cornell Med College.
- 10) Steven Bane, May 2007; Expression and Characterization of the Human Neurokinin 1 receptor from *E. coli*; current position, Process Engineer, Sterile Process Technology & Engineering, Merck & Co, West Point, PA.
- 11) Emily McCusker, December 2007; Overcoming Expression Obstacles in Producing Functional Components of the G-Protein Coupled Receptor Pathway; current position, post-doctoral fellow, Univ. London.

MChE Students

- 1) Sujata Bhatia, BChE/MChE, May 1999, Novel Role for Cysteines in *in vivo* folding of P22 Tailspike Protein; M.D./Ph.D, UPenn, 2003; current position, Medical Research Scientist, DuPont Central Research & Development, Wilmington, DE
- Honors include: 1998 Barry M. Goldwater Award, 1999 AIChE Student Paper Award, 1999 NSF and NDSEG graduate fellowships
- 2) Nicole Sheatsley Richardson, March 2005; Optimizing Extremophile Expression in Yeast; current position, Centocor, Malvern, PA.

Graduate Student Training: Chemistry-Biology Interface Program and IGERT program (6-8 weeks in laboratory)

Patrick McNeely, Ph.D. candidate, Chemical Engineering, Spring 2008
Scott Crown, Ph.D. candidate, Chemical Engineering, Spring 2008
Matthew Weitzman, Ph. D. candidate, Biology, Fall 2007
Angela Petiak, Ph.D. candidate, Biology, Fall 2006
Rebecca Brummitt, Ph.D. candidate, Chem. Eng, Spring 2006
David Johnson, Ph.D. candidate, Chem. Eng, Spring 2006
Sara Lawrence, Ph.D. candidate, Chem. Eng, Spring 2002
Chad Blamey, Ph.D. candidate, Chemistry, Winter 2001
Brenda Danek, Ph.D. candidate, Chem. Eng, Spring 1999
Steven Swann, Ph.D. candidate, Chemistry, Fall 1998

UNDERGRADUATE RESEARCH

Senior Theses

- 1) Jonathan Dueber (BS, 1999, Chemistry & Biochemistry) Expression, purification and refolding of tailspike aggregates; PhD, UC San Francisco, Dept of Biochemistry; currently Postdoctoral Fellow, California Institute for Quantitative Biomedical Research (QB3), University of California, Berkeley
- 2) Alexander Harris (BS, 2000) The Role of Stress in Protein Expression in Yeast
- 3) Eveline Tseng (BS, 2000) Analysis of the Interactions between human A_{2A} and BiP
- 4) Kathryn Whitehead (BS, 2002) Role of Additives in Preventing Aggregation of P22 Tailspike; currently in PhD program in Chemical Engineering at UC Santa Barbara, NSF Graduate Fellow Honorable Mention.
- 5) Noelle Commoli (BS, 2003) Tsf Mutations Alter the Rate and Pathway for Tailspike Aggregation, currently in PhD program in Chemical Engineering at Drexel University.
- 6) Eric Pridgen (BS, 2003) Molecular Sensors for Detecting Cellular Stress; Process Engineer for Merck for 3 years; currently in PhD program at MIT. NDSEG Department of Defense Graduate Fellow 2007-2010.
- 7) Ben Tang (BS, 2003) Role of Chaperones in Extremophile Expression in Yeast; currently in PhD program at Johns Hopkins University.
- 8) Dana Ungerbuehler (BS, 2003) Cysteine Mutation Effects on Tailspike Folding; MMDP Analyst, Merck Manufacturing Management Development Program for 2 years; currently at Rutgers Medical School.
- 9) Jennifer Zak [Grey] (BS, 2003) Role of Salt Bridging in Trimer Assembly of Tailspike; Process Engineer for Merck for 3 years; currently in UD MBA program
- 10) Amy VanFossen (BS, 2004) Stress Response in GPCR Expression in Yeast; currently in PhD program in Chemical Engineering at NC State University
- 11) Alison Wedekind (BS, 2005) Optimization and Characterization of G-Protein Coupled Receptor Expression in Yeast; currently in PhD program in Chemical Engineering at University of Minnesota
- 12) Elizabeth Bell (BS, 2005) Sublocalization of the Chaperone BiP within the Endoplasmic Reticulum of Yeast Cells and its Role in Protein Expression; currently in PhD program in Chemical Engineering at California Institute of Technology; 2004 Barry M. Goldwater Award.
- 13) Elizabeth Oeffinger (BS, 2006) Tailspike Beta Helix Variants: Effects of Sequence on Aggregation Propensity; currently in PhD program in Chemical Engineering at Princeton University.
- 14) Javier Velasquez (BS, 2007) Optimization of Rat Neurotensin Receptor Expression in *S. cerevisiae*
- 15) Dominic Mancini (BS, 2008) The unfolded protein response in G-protein coupled receptor expression in yeast
- 16) Lindsay Schmiedel (BS 2009)
- 17) Carly Fleagle (BS 2009)

Undergraduate summer research training

- Mark Richards (BS 2009, University of Delaware)
- Joshua Stottman (BS 2008, University of Delaware)
- Wayne Gibson (BS 2008, University of Delaware)
- Carine Tata (BS 2007, Chemistry and Biochemistry, University of Delaware)
- Erich Bozenhardt (BS, 2006, University of Delaware)
- Jessica Pippins (BS, 2006, University of Delaware)
- Matthew DeSeino (BS 2006, University of Delaware)
- Michael Schweizer (BS 2004, University of Delaware)
- Matt Eggers (BS, 2003, University of Delaware)
- Raymond Michael Hartley (BS, 2003, University of Delaware)
- Joe Peltier (BS, 2001, Washington University, St. Louis)
- Adi Kumiadi (BS, UMBC, 2001)
- Margaret Gentile (BS, 2000, University of Maryland)
- John Ristuccia (BS/Biotechnology, University of Delaware, 1998)

Undergraduate Senior Thesis Committees

Stephanie Myrick, BS 2008 (Sullivan)
Kristen Stoeber, BS 2004 (C. Robinson)
Matthew Panzer, BS 2002 (Lenhoff)
Porntula Panorchan, BS 2002 (Edwards)
Brian Eng, BS 2001 (Doyle)
Kara Odom, BS 1998 (Zydney)

POST-DOCTORAL STUDENTS SUPERVISED

Dr. Matthew Gage (2002-2005) PhD 2001, Biochemistry, Purdue University; Present Position: Assistant Professor of Chemistry, Northern Arizona University
Dr. David Raden (2002-present) PhD 2000, Biochemistry, U. Mass. Medical School
Dr. Asokan Anbanandam (Feb-Aug 2007) PhD 1999, Chemistry, Indian Institute of Technology, jointly advised by Prof. Tatyana Polenova; current position: Director, University of Kansas COBRE Biomolecular NMR Laboratory

THESIS COMMITTEES (Primary advisor is given in parentheses)

Xuankuo Xu, PhD 2008 (Lenhoff)
Andre Dumetz, PhD 2007 (Kaler/Lenhoff)

Yu-Chia Cheng, PhD 2007 (Lenhoff/Sandler)
John Langford, PhD 2007 (Lenhoff)
Claudio Gelmi, PhD 2006 (Ogunnaike)
Damien Thevenin, PhD 2006 (B. Bahnson, Chemistry)
Gabriella Santonicola, PhD 2006 (Kaler/Lenhoff)
Joshua Merritt, PhD 2005 (Edwards)
Yan Yao, PhD 2005 (Lenhoff)
Chun Wu, PhD 2005 (Y. Duan, Chemistry)
Matt Lee, PhD 2004 (Y. Duan, Chemistry)
Erin Brachman, PhD 2004 (E. Kmiec, Biology/DBI)
Camelia Owens, PhD 2004 (Doyle)
Beelin Cheang, PhD 2004 (Zydney)
Maria Frost Ebersold, PhD 2004 (Zydney)
Sonali R Raje, PhD 2003 (C. Thorpe, Chemistry)
Steven Dziennik, PhD 2002 (Lenhoff)
Radakrisnan Mahadevan, PhD 2002 (Doyle)
Jonathan Romero, PhD 2002 (Zydney)
Kapil Gadkar, MS 2002 (Doyle)
Rajanikanth Vadigepalli, PhD 2001 (Doyle)
Yi-Fang Chu, MS 2001 (Lo, Animal and Food Science)
James Lease, MS 2000 (Dan)
Vassiliki Tegoulia, PhD 2000 (Cooper)
Wei Yuan, PhD 1999 (Zydney)

Thesis research in progress

Kory Blocker (Sullivan)
Melissa Bonner (E. Kmiec, Biological Sciences)
Rebecca Brummitt (Roberts)
Subhendu Chakraborti (B. Bahnson, Chemistry)
Zeynep Firtina (M. Duncan, Biological Sciences)
Jennifer Roth Illuzzi (E. Kmiec, Biological Sciences)
David Johnson (Beris/Naik)
Kelley Kearns (Lenhoff)

Rachel Lewus (Kaler/Lenhoff)
Ronak Maheshwari (K. Kiick, Mat'l Sciences)
Sergios Nicolaou (Papoutsakis)
Deepika Vuppalaanchi (J. Twiss, Biological Sciences)
Jason Winget (B. Bahnson, Chemistry)
Charles (Chuck) Woods (Roberts)
Theresa Yuraszeck (F. Doyle, UCSB)

CURRENT FUNDING

National Science Foundation

C. Roberts (PI) A.S. Robinson (co-PI) Erik Fernandez (co-PI, UVA)

Collaborative Research: Towards a General Design Approach to Arrest Non-Native Aggregation of Multi-Domain Proteins

6/1/2009 - 5/31/2012

Total UD Costs: \$418,632

The major goals of this project are to lay a foundation both to fill the gaps in fundamental understanding of the mechanism(s) of multi-domain protein aggregation, and to provide first-generation design rules to imbue aggregation resistance, using the protein gamma-D crystallin as a model protein.

National Institutes of Health

A. Robinson (Lead PI), Co-PI's F. J. Doyle, L. R. Petzold, D. Raden

Stochastic Modeling of Protein Interactions in the ER

4/1/05-3/31/09

Annual Direct Costs: \$235,939

The major goals of this project are to integrate biological scientists with engineers to develop a fundamental understanding of cellular networks and create a methodology to explain it. Specific target systems include the network of protein interactions that retain ribosomes at the rough endoplasmic reticulum and their effect on translocation; and examination of BiP regulation and localization via binding to co-chaperones.

National Institutes of Health

1 P20 RR15588/ A. Lenhoff (Lead PI), Co-PIs: A.S. Robinson, P. DeLeon, B.J. Bahnson, U. Naik, E.W. Kaler, B-C Yoo, J-Y Lee

COBRE: Membrane Protein Production and Characterization

7/1/05-6/30/10

Annual Direct Costs: \$2,182,446

The major goals of this project are to improve production, isolation, and characterization of membrane proteins from mammalian, yeast, or bacterial systems.

National Science Foundation

IGERT Multidisciplinary Graduate Program in Biotechnology

0221651/ A. Robinson (Lead PI), Co-PIs: M. Duncan, J-Y Lee, J. Sawyer, D. Pochan, J. Schneider
12/15/02-12/16/08
Annual Direct Costs: \$555,000

The major goals of this project are to develop a graduate program that creates new scientists who not only excel in leading-edge protein science and technology, but who also are 1) well-equipped to work and solve problems collaboratively across multiple disciplines; 2) have value for diverse views and people; and 3) understand how their training can impact the world as either academic or industrial professionals

PAST FUNDING

National Institutes of Health
1F33 AG031610/ A. Robinson (Lead PI)
Tau Homeostasis and Neurodegeneration
12/1/07-11/30/08

Annual Direct Costs: \$56,708

The major goals of this research are to understand the role of the unfolded protein response in tau production, degradation, and tangle formation in neuronal degeneration with ultimate application towards Alzheimer's Disease.

National Institutes of Health/PHS
1 R01 GM65507-01/ A. Robinson (Lead PI), Co-PIs: F. J. Doyle III
Sensing and Analyzing Stress during Protein Expression
Project Period: 3/1/02-2/28/05

Total Direct Costs: \$466,638

The major goals were to understand the role of the chaperone BiP in the unfolded protein response and to model the interactions between BiP and a heterologous protein during protein expression.

National Science Foundation
"CAREER/PECASE: Characterization, Inhibition, and Reversal of Protein Aggregation"
Total Direct Costs: \$520,000

Project Period: 6/1/2000-5/31/2005

The goals of this proposal were to understand and inhibit protein aggregation, by determining the conformation features of tailspike aggregates, as well as the kinetics of aggregation.

National Institutes of Health
"Characterization of Novel Cysteines of P22 Tailspike Protein"
Total Direct Costs: \$440,000

Project Period: 10/1/2000-9/31/2003

This proposal focused on the role of cysteine residues in determining protein folding propensities for P22 tailspike protein.

National Institutes of Health
"COBRE: Structural and Functional Genomics"

Total Direct Costs: \$6,885,774

Project Period: 9/30/00-9/30/05

Co-PIs: AM Lenhoff, BJ Bahnson, Y Duan, AS Robinson, JS Edwards, U Naik, EW Kaler, M Jain

The major goals of this project are to develop a multidisciplinary collaborative center of expertise in determining and exploiting protein structure-function relations.

DuPont Company
DuPont Young Professor
Amount: \$25,000
Project Period: 6/1/2000-5/31/2005
Unrestricted funding.

University of Delaware Research Fund
"Optimization of Folding and Expression of Enzymes from Extreme Environments"
Amount: \$30,000
Project Period: 6/1/2000-5/31/2001
The goal of this research was to express extremophilic enzymes from archae in the microorganism yeast in order to improve expression of these potentially valuable enzymes.

Petroleum Research Fund of the American Chemical Society
"Production of Thermophilic Enzymes in Extreme Environments"
Amount: \$25,000
Project Period: 9/1/2000-8/31/2002
The goal of this research was to maximize expression of extremophilic enzymes from archae.

PROFESSIONAL SERVICE

National and local organization leadership

2009 Co-Chair – Biochemical Engineering XVI
2008-2010 ACS BIOT Division Awards Chair
2007 Advisory Board, BioXXcel Educational Project (NSF DUE 0633373, PI: Komives; co-PIs: Fernandez, Beitle)
2007 Vice-Chair – Biochemical Engineering XV
2006-10 Member, Advisory Committee for Pharmaceutical Sciences, Food and Drug Administration
2006 Chair – American Chemical Society BIOT Division
2005 Chair Elect – American Chemical Society BIOT Division
2004 Program Co-Chair – American Chemical Society BIOT Division
2001 Member, NSF Future of Engineering Education Workshop, July 16-17 2001
2000 Chair and Organizer – Mid-Atlantic BioEngineering Consortium (MABEC) Conference,
1995-97 Provost's National Advisory Board for the Initiative to Diversify the Professoriate in Engineering and Science, MIT

Session Chair or Co-Chair

2006 Co-Chair, Membrane Protein Expression and Characterization, 2006 ACS Mtg, SF
2002 Chair, Protein Engineering and Biocatalysis, 2002 AIChE Fall Meeting, Indianapolis
2001 Chair, Advances in Protein Expression, 2001 AIChE Fall Meeting, Reno
2000 Co-Chair, Advances in Protein Expression, 2000 AIChE Fall Meeting, Los Angeles
1999 Chair, Young Faculty Forum, 1999 AIChE Fall Meeting, Dallas
1999 Co-chair, Advances in Protein Expression, 1999 AIChE Fall Meeting, Dallas
1999 Chair, Biosensors Session, 1999 Organic Thin Films Gordon Conference, Newport, RI
1998 Co-chair, Young Faculty Forum, 1998 AIChE Fall Meeting, Miami

1998 Co-chair, Protein Folding and Stability session, ACS BIOT Division, Boston, MA

Reviewer for the following journals and organizations

AIChE Journal
Applied Environmental Microbiology
Biochemistry
Biotechnology Progress
Enzyme and Microbial Technology
Industrial & Engineering Chemistry Research
Journal of the American Chemical Society
Journal of Biotechnology
Nature Biotechnology
Protein Science
Cambridge University Press

Editorial Boards

Biotechnology and Bioengineering
Biotechnology Journal

National Science Foundation

Chair, ASEE/NSF Graduate Research Fellowships Chem. Eng. Panel, 2009
Ad hoc reviewer for Biology and Engineering Directorates
Panel reviewer for Exploratory Research in Biosystems at the Nanoscale
Panel reviewer for CAREER awards
Panel reviewer for MathBio awards
Panel reviewer for ASEE/NSF Graduate Research Fellowships, 2008, 2007, 2006, 2004
Member, NSF Future of Engineering Education Workshop, July 16-7 2001

National Institutes of Health

Chair, Special Emphasis Panel ZGM1 MBRS-2 (CO), 2008
SBIR panel review (DDD – BCMB), 2007
Protein Structure Initiative II (P50) study section, 2005
BBCA / MSF-B Ad Hoc member, 2004
Program Project Grant panel review – P01 ZRG1 BIO 01, 2002
SBIR panel review (ZRG1 SSS-2), 2002

Petroleum Research Fund, American Chemical Society
U.S. Civilian Research and Development Foundation (CRDF)

Society Member

1986- Tau Beta Pi
1988- Sigma Xi Research Society
1986- American Institute of Chemical Engineers (AIChE)
1992- American Chemical Society (ACS)
1997- Biophysical Society
1995- Protein Society

UNIVERSITY

2008-2009 College of Health Sciences Dean search committee

2004-2008	IGERT Director
1999-2007	Met with prospective students at Blue and Gold Days, Delaware Decision Days, Delaware Discovery Days, DuPont Scholars Weekends, made follow-up phone calls to encourage enrollment
2001-2006	Health Sciences Education Advisory Committee
2001-2002	Plant Sciences Faculty Search Committee
2001 -2006 member	Howard Hughes Medical Institutes (HHMI) Undergraduate Research Advisory Board
1999-2001	HHMI Undergraduate Summer Research Reviewer

COLLEGE

1999-2006	Society of Women Engineers (SWE) Faculty Advisor, University of Delaware
2005, 2006	Materials Science P& T Committee
2002	College of Engineering Merit Award committee
1999	Engineering Concepts Workshop – organized material to aid local high school teachers develop biotechnology lectures

DEPARTMENT

2008-present	Associate Chair for Biochemical Engineering
2007	Department Chair search committee member
2004-2007	Faculty search committee member
2000-present	Undergraduate Advisor
2005	Department Chair search committee member
1998-2002	Departmental Seminar Coordinator
2001-2002	Faculty search committee member
2001-2002	Curriculum committee member
2001-2002	Chair, Bioengineering Curricula committee
2001	Administrative Coordinator Search committee
2000	Department Chair search committee member
2000	Administrative Coordinator Search committee
1999-2000	Associate Professor search committee member
1998	Ph.D. Written qualifier exam, co-organized with Raul Lobo